Ahern State Park Bacteria Source Identification Study June 2004

Prepared by: New Hampshire Department of Environmental Services

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Department of Environmental Services (DES) personnel met with the Ahern State Park Advisory Committee and representatives of the City of Laconia in December 2002 to discuss the water quality of Ahern State Park Beach on Lake Winnisquam and Governor Park Stream. These discussions were specifically about concerns raised by the presence of *Escherichia coliform* (*E. coli.*) bacteria in water samples collected in the Ahern State Park area by the Lake Winnisquam Volunteer Lake Assessment Program (VLAP). As a result, in 2003, DES performed a sanitary survey and water quality monitoring for the Ahern State Park area, including the beach area and the Governor Park Stream watershed. The purpose of this investigation was to identify possible sources of *E. coli* bacteria. The results are summarized below. The lead investigator for this study was Andrew Chapman of the DES Watershed Management Bureau.

1.0 Study Area Description and Site Visit Observations

Table 1 provides a summary of DES activities that took place in 2003. DES staff conducted several site visits to collect information, survey the watershed for potential contamination sources and implement the sampling program. Staff from the Lakes Region Correctional Facility, City of Laconia Department of Public Works, the Department of Resources and Economic Development (DRED) and DES's Winnipesaukee River Basin Program (WRBP) staff were instrumental in providing site access and information for facilities in the study area.

1.1 Ahern State Park

Ahern State Park is owned by the State of New Hampshire and operated by DRED. It includes 128 acres, with 3,500 feet of shoreline on Lake Winnisquam. Activities in the park include swimming, fishing, biking, hiking and picnicking. The park was transferred to the State in November, 1994 as Governor's State Park, and renamed Ahern State Park in 1998. The park is open year-round and is free to the public. Access to the park beach area is by an unpaved dirt road. Public toilet facilities for beach users are provided by a privy located near the beach. No evidence was observed that this privy is a contamination source to Lake Winnisquam. However, the privy did not appear to have the 4 feet of separation to seasonal high water table required for open-bottomed privies in DES Subsurface System Bureau Regulations (Rule Env-Ws 1022.01). This should be further assessed by DRED and the facility modified or relocated, as necessary, to achieve compliance. No other obvious potential contamination sources were observed at the park.

1.2 Governor Park Stream Watershed

The Governor Park Stream watershed is delineated on Figure 1. The undeveloped portion of the watershed is forested, moderately sloped land with well-drained soils. Most of the developed portion of the 110-acre watershed is located within the property boundaries of the Lakes Region Correctional Facility, which is partially located in this watershed.

The Correctional Facility is owned by the State of New Hampshire and operated by the Department of Corrections. It currently houses medium and minimum security male and female offenders in various buildings on the facility grounds. DES reviewed available plans and walked the grounds to view the facility infrastructure including the buildings, wastewater and stormwater sewer systems,

paved areas, and a small pond on the grounds named Fish Pond. Most of the buildings and associated infrastructure, including the sanitary and stormwater sewers, which are in close proximity to each other in some locations in the facility yard areas, were constructed in the early 1900s. The sanitary and stormwater sewer systems were determined to be the most likely sources for contamination by *E.coli* bacteria on the correction facility grounds

Sanitary wastewater from the Correctional Facility buildings is discharged to vitrified clay tile pipes, most or all of which were installed in the early 1900's. Wastewater then flows through about 2,200 feet of 10-inch polyvinyl chloride (PVC) interceptor pipe, installed in the 1997 as a replacement for some of the original sewer, to WRBP's State School Pump Station. The State School Pumping Station was constructed in 1978 to eliminate an inadequately treated wastewater discharge to Lake Winnisquam from the Correctional Facility. The pump station is located approximately 150 feet from the easterly shoreline of Lake Winnisquam at the southernmost end of Ahern State Park (see Figure 1). The pump station discharges to a 10-inch force main which follows the shoreline for much of its 2500 feet length before discharging into the City of Laconia's sanitary sewer located on Shore Drive. WRBP staff reported that no failure has ever occurred which resulted in an overflow of sewage from this pump station. Based on this history and field observations, the pumping station is not a source of contamination to Lake Winnisquam. Furthermore, should any disruption in pump station operation occur, it would trigger an alarm resulting in rapid inspection by WRB Program staff and appropriate corrective measures. Therefore, risk of future contamination is low.

Stormwater from the Correctional Facility grounds located in the Governor Park Stream watershed mostly runs off into catch basins then flows through a piping system of vitrified clay tile and concrete pipe. Discharge from the stormwater system is to Governor Park Stream which then flows to Lake Winnisquam at the northerly end of Ahern State Park Beach. Governor Park Stream is a small stream, approximately 0.4 miles long. The stream flows most of the year, being partially fed by groundwater, Fish Pond, and seasonal streams from the forested hillsides. Flow was observed to be minimal during dry weather periods in the summer months. During summer rainfall events of short duration, stream flow frequently consists mostly of runoff from the Correctional Facility grounds.

2.0 Lake Winnisquam VLAP Water Quality Sampling Results (August 1997- March 2003)

Between August 1997 and March 2003, eight sampling events were conducted by the Lake Winnisquam VLAP. Sampling stations are presented in Figure 2, with stations established by the VLAP denoted by capital letters ("A", "B", "C", etc.). Table 2 summarizes the VLAP sample results and also includes daily rainfall totals reported from the Laconia, NH weather station. Note that the time of sampling in relation to time of rainfall was not recorded so the correlation between rainfall event and water quality is not clear for this limited data set.

Exceedances of the 406 *E. coli.*/100 ml standard for Class B water at non-beach areas were only reported for October 17, 2002, one day after a rainfall event, at Sampling Station E (the Governor Park Stream Upper), and Sampling Station G (the Fish Pond outlet). No other violations of surface water quality standards were documented. However, other elevated *E. coli.* concentrations (greater than 200 counts/100 mL) that did not exceed Class B water quality standards were also reported for several other sampling events at several locations in Governor Park Stream. These results raised sufficient concern to merit additional investigation by DES in 2003, at the request of the Ahern

State Park Advisory Committee.

3.0 Summer 2003 Water Quality Sampling Results

In 2003, DES conducted water quality sampling for *E. coli.* bacteria during three rainfall events, two in July and one in August, as well as for two dry weather days. Table 3 presents the results for these sampling events. The sampling locations are shown on Figure 2.

3.1 July 2003 Results

Sample collection in July was to broadly assess the watershed and beach area for possible contamination sources. In samples collected during rainfall events on July 11 and July 16, the maximum *E. coli.* concentrations at four key sampling locations were:

- 8,200 *E. coli.*/100 mL at Governor Park Beach Stream culvert outlet.
- 9,600 *E. coli.*/100 mL at the Governor Park Beach Stream Mouth.
- Greater than 20,000 *E. coli.*/100 mL at Laconia Correctional Facility stormwater discharge
- 11,400 *E. coli.*/100 mL at Ahern State Park Beach on July 16, 2003 at the "Beach-Right" sampling station.

These results show significant exceedances of the Class B surface water quality standard of 406 counts/100 mL.for *E. coli* for single samples for non-beach areas.

The Ahern State Park beach area had three sampling stations, designated Beach-Left ("LF"), Beach-Center ("CR") and Beach-Right ("RT") looking from the shore towards Lake Winnisquam. The "Beach-Right" station, near the outlet of Governor Park Stream had violations of the 88 *E. coli./*100 mL (single sample) water quality standard for beaches on both July 11, 2003 and July 16, 2003. The "Beach-Center" station exceeded the 88 *E. coli.*/100 mL standard with 140 counts/100 mL on July 11, 2003. The "Beach-Left" station, located the furthest from the Governor Park Stream outlet, showed no *E. coli.* standard violations. None of these sample stations had water quality violations during dry weather sampling on July 18 and 24, 2003.

3.2 August 4, 2003 Results

The August 4, 2003 sampling program was focused on the Correctional Facility stormwater system and Governor Park Stream, which receives the stormwater system discharge, during a rain event. Sampling was performed pre-rain and post-rain (see Table 3). The rainfall event was a relatively short, intense, localized rainstorm that included a 15-minute period with 0.1 to 0.2 inches of precipitation. During and after this storm, no discharge was observed from Fish Pond, so these results were indicative of water quality in stormwater discharged directly from the Correctional Facility area.

The results of the pre-rain "dry" samples (Sample Round # 1), collected at 11:30 AM, indicated low levels of *E. coli.*, with a maximum concentration of 50 *E. coli./*100 mL. The wet weather samples (Sample Rounds #2 and #3) were collected about 26 minutes apart, at 13:55 (1:55 PM) and 14:21 (2:21 PM). Moving upstream to downstream (see Figure 3) through the Correctional Facility storm sewer system to the stream outlet at Ahern State Park Beach, key sampling results were as follows:

- At Sample Station PS 024, located in the upper portion of the Correctional Facility stormwater collection system, *E. coli*. concentrations were low, 20-40 counts/100 mL.
- Sample Stations PS 015, PS 016, and PS 019, located downstream of PS 024 in the Correctional Facility stormwater system, exhibited elevated *E. coli*. concentrations that ranged from 180 counts/100 mL to 15,900 counts/100 mL. At each of these locations, *E. coli.* concentrations increased from Round #2 to Round #3, indicating that stormwater quality had quickly degraded within a short period of time.
- Sample Station PS 004, located in the lower reaches of the Correctional Facility stormwater system, also exhibited elevated *E. coli.* concentrations, 6,700 counts/100 mL in Round #2 and 11,900 counts/100 mL in Round #3.
- At Sample Station F, where the culvert discharges to Governor Park Stream, *E. coli.* concentrations were 9,000 counts/100 mL (at an estimated flow at the culvert outlet of 50 gpm).
- At Sample Location B, located at the discharge of Governor Park Stream to Lake Winnisquam. near Ahern State Park Beach, *E. coli.* concentrations were lower, 280 counts/100 mL, suggesting stormwater dilution.
- At the beach area in Lake Winnisquam, *E. coli.* levels were less than 10 counts/100mL at all three beach sampling stations.

4.0 Conclusions

1. During dry weather, water quality samples collected from all three sampling stations at Ahern State Park Beach consistently met surface water quality standards for beach areas.

2. During the July rainfall events, exceedances of the 88 *E. coli.*/100 ml water quality standard for beaches occurred at the "Beach-Right" and "Beach-Center" sampling stations, located near the Governor Park Stream outlet. All samples analyzed from the "Beach-Left" sampling station met the *E. coli.* standard for beaches. This suggests that water quality degradation at the beach area during and after rainfall events is directly associated with stormwater flow from Governor Park Stream. However, during the August sampling, no exceedances were measured.

3. During, and immediately after, stormwater events, water quality in Governor Park Stream consistently violates the Class B water quality standard of 406 *E. coli.*/100 ml for surface waters at non-beach areas.

4. *E. coli.* levels consistently exceeded water quality standards in stormwater samples collected from the Correctional Facility stormwater system. This suggests that the stormwater system is a significant source of *E. coli.* bacteria in Governor Park Stream.

5. Investigations of the Correctional Facility grounds revealed no obvious surface sources of *E. coli.* bacteria during rain events.

6. Based on interviews with maintenance staff, the Correctional Facility stormwater and sanitary sewer systems consist primarily of old clay pipes mostly installed in the early

1900's. Old vitrified clay pipes are frequently quite leaky. Consequently, clay pipe exfiltration and infiltration are possible sources of the *E. coli.* bacteria identified in the stormwater system that should be further investigated. It is likely that Department of Corrections will ultimately need to upgrade its stormwater or sewer system piping to improve water quality in Governor Park Stream.

5.0 Recommendations

1. Additional investigations to identify and correct wet weather sources of *E.coli.* bacteria should be conducted by the Department of Corrections, with assistance from DES, focused on the stormwater drainage and sanitary sewer systems on the Correctional Facility grounds. The Department of Corrections also should ultimately evaluate long term alternatives to upgrade the stormwater drainage and sanitary sewer systems for this facility.

2. The Ahern State Park Beach area should be routinely sampled for *E. coli.* bacteria, especially immediately after rainfall events, to establish and confirm water quality for beach areas. Bacteria levels should be correlated with the magnitude of rainfall events to establish an understanding of this relationship in the beach area for beach management purposes. DRED, with assistance from DES, should develop criteria for when beach advisories should be posted after rainfall events due to actual or potential contamination.

3. The Ahern State Park Beach privy does not appear to have the 4 feet of separation to seasonal high water table required for open-bottomed privies in DES Subsurface System Bureau Regulations (Rule Env-Ws 1022.01). This should be further assessed by DRED and modified or relocated, as necessary, to achieve compliance.

Table 1
Ahern State Park Site Investigation Activities by the Department of Environmental Services
(March-August, 2003)

Date	Description
3/27/03	Met with Frank Tilton, Public Works director to get copies of sewer line locations
4/15/03	Met with Dave Carrigan, Lakes Region Facility to conduct survey of Governor Park Stream watershed
7/11/03	Full round of wet weather sampling, all sites
7/14/03	Partial round of sampling, specific to Ahern State Park beach area
7/16/03	Partial round of wet weather sampling focusing on Correctional Facility stormwater system
7/18/03	Partial round of sampling, specific to Ahern State Park beach area
7/21/03	Dry weather sampling to determine if kitchen waste pipe in Correctional Facility was causing elevated bacteria
7/24/03	Partial round of sampling, specific to Ahern State Park beach area
8/4/03	Wet weather sampling, multiple rounds on Correctional Facility property

Table 2
Governor Park Stream Bacteria Sample Results from Volunteer Lake Monitoring Sampling Program
(August, 1997 - March, 2003)

		Sample Date							
		8/14/97	8/13/98	8/18/00	8/14/02	10/17/02	11/12/02	12/4/02	3/27/03
		Rainfall (inches)							
Antecedent Rainfall (4 days prior)		0.00	0.00	0.43	0.00	0.19	0.00	0.00	0.00
Antecedent Rainfall (3 days prior)		0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Antecedent Rainfall (2 days prior)		0.00	0.50	0.07	0.00	0.00	0.00	0.00	0.00
Antecedent Rainfall (1 day prior)		0.29	0.89	0.00	0.00	0.47	0.14	0.00	0.00
Antecedent Rainfall (day of)		0.00	0.00	0.00	0.00	0.02	0.65	0.00	0.15
Total Rainfall (day of to 4 days prior)		0.59	1.39	0.50	0.00	0.68	0.79	0.00	0.15
Station ID	**Map Code**	**E.coli= # colonies per 100 ml**							
Governor Park Beach (VLAP Site)	A	11	16		6				
Governor Park Beach/ Stream Mouth	B					240			
Governor Park Stream (VLAP Bridge #1 Site)	C	31	200	210			5		
Governor Park Stream Below Gate (Bridge #2)	D						10		
Governor Park Stream Upper	E				>200	490 [1]			
Governor Park Stream Culvert	F					160	100	<10	
Fish Pond Inlet (actually downstream of outlet)	G					600 [1]	10		
Fish Pond Pipe (actual outlet)	H							<10	
Fish Pond	I						<10		
Culvert discharge to open manhole	J								29

Note:
[1] Results that exceeded NH DES water quality standards of 406 E. coli colonies per 100 ml for Class B surface waters not regularly used for swimming are highlighted gray.

Table 3
Governor Park Stream Bacteria Sample Results, Summer 2003 DES Sampling Program

		Date/Type of Event								
		7/11/03	7/14/03	7/16/03	7/18/03	7/21/03	7/24/03	8/4/03	8/4/03	8/4/03
		Wet	Follow-up	Wet	Follow-up	Dry, new sites	Follow-up	Round #1 -Dry 11:30	Round #2-wet 13:55	Round #3-wet 14:21
		Rainfall (inches) **observed at Laconia Airport**								
Antecedent Rainfall (4 days prior)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Antecedent Rainfall (3 days prior)		0.00	0.16	0.00	0.00	0.05	0.00	1.70	1.70	1.70
Antecedent Rainfall (2 days prior)		0.02	0.00	0.00	0.01	0.00	0.04	0.13	0.13	0.13
Antecedent Rainfall (1 day prior)		0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.0
Antecedent Rainfall (day of)		0.15	0.00	0.01[1]	0.05	0.00	0.04 [2]	0.01 [3]	0.1-0.2 [3]	0.1-0.2 [3]
Total Rainfall (day of and 4 days prior)		0.17	0.16	0.01	0.06	0.05	0.44	1.84	1.84	1.84
Station ID	**Map Code**	**E.coli= # colonies per 100 mL**								
Governor Park Beach (VLAP Site)	A	ns								
Governor Park Beach/ Stream Mouth	B	>2000 [4]	80	9600 [4]	160		126			280 (37 gpm)
Governor Park Stream (VLAP Bridge #1 Site)	C	9,800 [4]								
Governor Park Stream Below Gate/Bridge #2	D	>2,000 [4]								
Governor Park Stream Upper	E	ns								
Governor Park Stream Culvert	F	>2000 [4]	70	8200 [4]	50		44			9000 [4] (50 gpm)
Ahern St. Pk. Beach Left: BCHASPLAC-LF	LF	<10	2	<10	<2		12			9
Ahern St. Pk. Beach Center: BCHASPLAC-CR	CR	140 [4]	4	<10	0		10			9
Ahern St. Pk. Beach Right: BCHASPLAC-RT	RT	>2000 [4]	6	11400 [4] (>400 gpm)	3		14			<10
Correctional Facility: 996-PS004	PS004	ns		>20000 [5]				30	6700 [5]	11900 [5]
Correctional Facility: 996-PS005	PS005	>2000 [5]								
Correctional Facility: 996-PS006	PS006	>2000 [5]								
Correctional Facility: 996-PS009 (flows not discharging to stream)	PS009	>20000 [5]		45000 [5]						
Correctional Facility: 996-PS014	PS014			500 [5]						
Correctional Facility: 996-PS015	PS015			4700 [5]				NF	1700 [5]	2700 [5]
Correctional Facility: 996-PS016	PS016			4000 [5]		50		30	10600 [5]	15900 [5]
Correctional Facility: 996-PS017	PS017			1200 [5]						
Correctional Facility: 996-PS018	PS018			200						
Correctional Facility: 996-PS019	PS019			13200 [5]				NF	180	5500 [5]
Correctional Facility: 996-PS022	PS022					50				
Correctional Facility: 996-PS023	PS023					30				
Correctional Facility: 996-PS024 (very low flow, <1 GPM)	PS024							50	200	4600 [5]
Correctional Facility: 996-PS026	PS026							<10	30	40

Notes: (see next page)

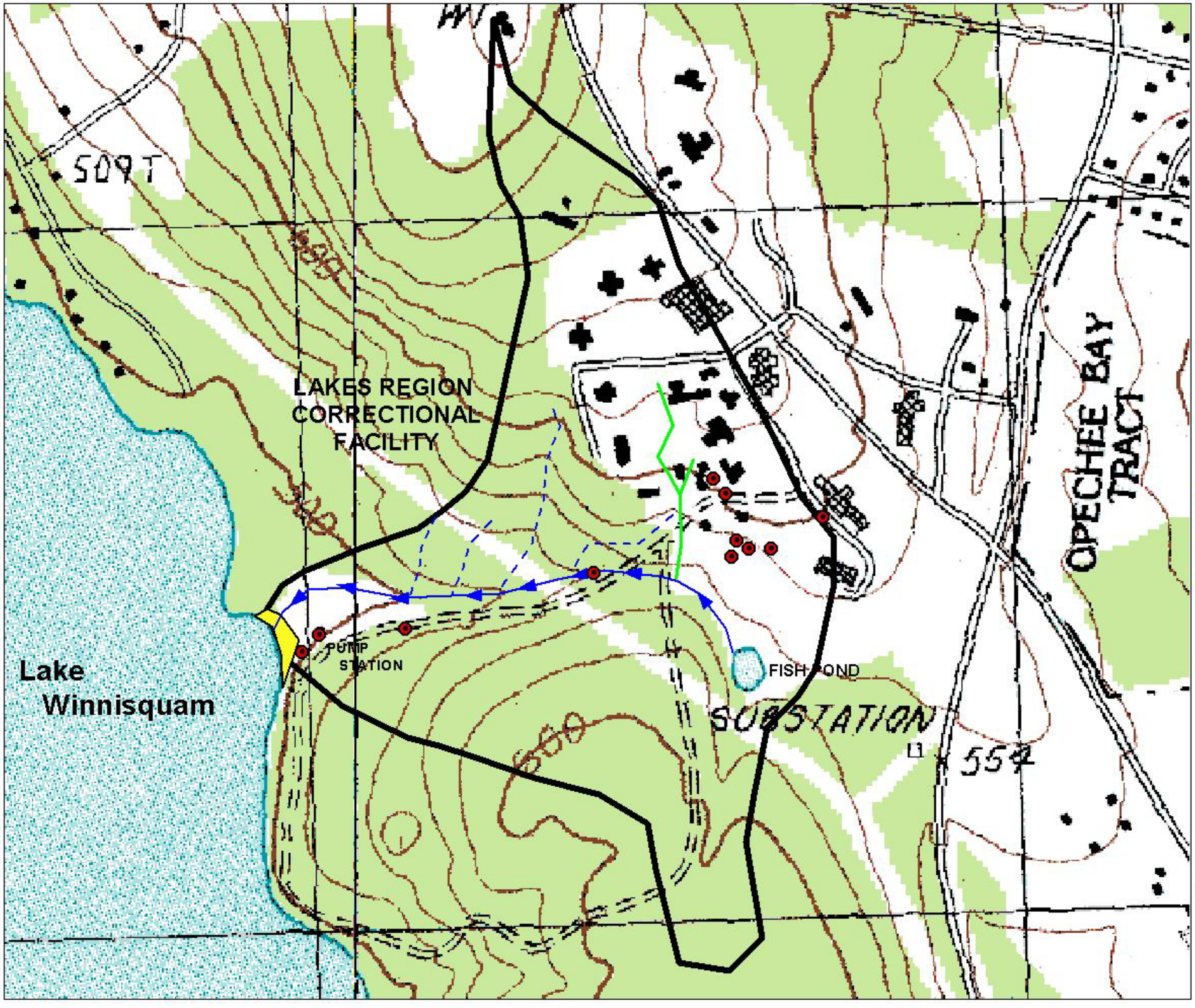
*nf= no flow ns= no sample

[1] Rainfall amounts observed were more than those documented by the Laconia Airport weather station.
[2] Rainfall on 7/24/03, started during sample collection, therefore little rain influence on water quality was likely.
[3] Rainfall on 8/4/03 was a localized event not recorded by the Laconia Airport weather station. Rainfall started at 1340, lasted until 1355. Estimate 0.1-0.2 inches of rain.
[4] Results that exceeded NH DES Water Quality Standards for designated beaches or Class B Waters are highlighted yellow.
[5] Results that exceeded NH DES Water Quality Standards but are "in-pipe" and therefore not technically considered violations are highlighted in orange.

Figure 1

Winnisquam, Laconia, Ahern Park

Governor Park Stream Watershed



N
W E
S

- Pump Station
- Sewer Manhole
- Governor Park Stream
- Seasonal Stream
- Storm Water Line
- Beach
- Gov. Park Stream Watershed

The coverages presented in this program are under constant revision as new sites or facilities are added. They may not contain all of the potential or existing sites or facilities. The Department is not responsible for the use or interpretation of this information, nor for any inaccuracies.

Map Prepared by Andy Chapman, January 30, 2004.

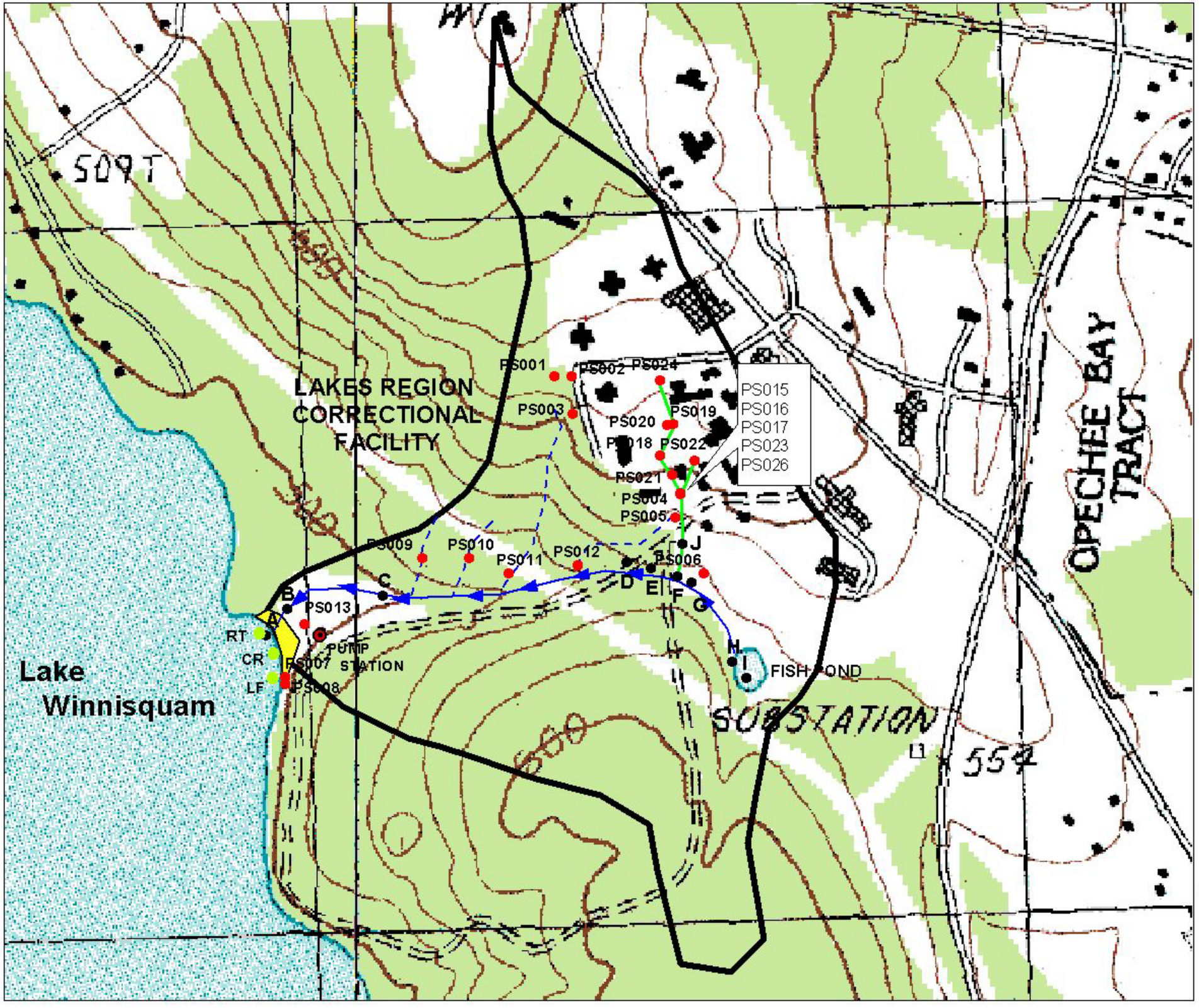
* Watershed Boundry Approximated

0.05 0 0.05 0.1 0.15 0.2 Miles

Figure 2

Winnisquam, Laconia, Ahern Park

Governor Park Stream Sampling Sites



N

W E

S

- Pump Station
- Beach Sites
- Potential Pollution Sources
- Sample Stations
- Governor Park Stream
- Seasonal Stream
- Storm Water Line
- Beach
- Gov. Park Stream Watershed

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Map Prepared by Andy Chapman, January 30, 2004.

Potential Pollution Sources include stormwater pipes, catch basins, perennial, streams, seasonal streams and the Fish Pond.

* Watershed Boundry Approximated

0.05 0 0.05 0.1 0.15 0.2 Miles